



New England
Aquarium

PENGUINS

TEACHER GUIDE



Penguin Teacher Guide

Introduction

Penguins are birds, and like other birds, they have wings and are covered with feathers. They lay eggs and are warm-blooded animals.

Penguins evolved from the flying birds of more than 40 million years ago. The first penguin fossil fragments were found in New Zealand in the mid-1800s. To date, the discovery of all penguin fossil fragments has been limited to the Southern Hemisphere. The closest living relatives to penguins are the albatrosses, shearwaters, petrels, loons and grebes.

The origin of the word penguin has been a subject of debate. Theories range from references to the amount of fat penguins possess (*penguigo* in Spanish and *pinguis* in Latin) to the claim that the word was derived from two Welsh words meaning “white head.” The most agreed-upon explanation is that penguin was used as a name for the now-extinct great auk, which the modern-day penguin resembles and for which it was mistaken.

Scientific Classification

Kingdom: Animalia

Phylum: Chordata

Class: Aves

Order: Sphenisciformes

Family: Spheniscidae

Genera: Aptenodytes, Eudyptes, Eudyptula, Megadyptes, Pygoscelis, Spheniscus

Distribution and Habitat

All 17 species of penguins live in the Southern Hemisphere. Penguins generally live on islands and remote continental regions that are free of land predators, where their inability to fly is not detrimental to their survival. Penguin species are found on every continent in the Southern Hemisphere. They are abundant on many temperate and sub-Antarctic islands. Different species thrive in varying climates, ranging from Galapagos penguins on tropical islands at the equator to emperor penguins restricted to the ice of Antarctica.

These highly specialized marine birds are adapted to living at sea. Some penguin species spend as much as 80% of their lives in the ocean. They usually are found near nutrient-rich, cold-water currents that provide an abundant supply of food.

Physical Characteristics

There are 17 different species of penguins, and they vary in size and shape. The emperor penguin is the largest of all living penguins, standing at 4 feet and weighing 90 pounds. The smallest of the penguins is the little blue penguin, standing just 10 inches and weighing about 2.5 pounds.

Everything about a penguin is fine-tuned for **swimming**. Their body is rounded in the middle and pointed at either end, which is the perfect shape for sliding through water. Their powerful, flipper-like wings propel them through the ocean. Penguins are awkward on land, but their short legs and webbed feet are the perfect rudder system underwater. And unlike other birds, penguins have solid bones. This added weight counteracts their natural buoyancy and helps them move quickly through water.

Penguins use their torpedo-shaped body to shoot through water at speeds of 15 miles per hour or more. Some penguins leap into the air while swimming—a trick known as porpoising.

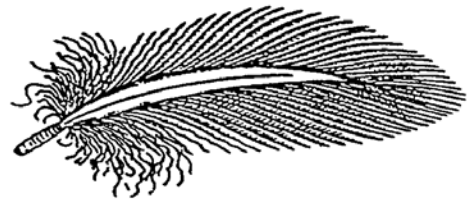
Penguin legs are short and strong. Their feet are webbed, with visible claws. Penguins walk with short steps or hops, sometimes using their bills or tails to assist themselves on steep climbs. Some species, like the rockhopper, jump from rock to rock. Antarctic species can move much faster over ice by “tobogganing” on their bellies, using their flippers and feet to help them move along.

Their tuxedo-like black and white coloring is extremely effective **camouflage**—known as countershading—which helps them hide from predators and prey in the open ocean. For example, if a shark or other predator swims below a penguin, the penguin’s white belly blends in with the bright sunlight coming from above. Likewise, if a penguin swims below some fish it wants to catch, its black back blends in with the dark depths of the sea. Different species of penguins can be identified by their head and facial markings.

Penguins only **eat** seafood and swallow their food whole since they don’t have teeth. They use their powerful, hooked beaks to catch fish, squid and krill. Their tongues have a rough, Velcro-like texture that helps them hold and swallow their slippery food. The New England Aquarium’s 65 penguins eat nearly 600 pounds of sardine, capelin, smelt and herring every month. Most of them eat five to ten fishes every day.

Like many animals, penguins have a nictitating membrane, sometimes called a third eyelid. This is a clear covering that protects the eye from injury.

A penguin’s tail is short and wedge-shaped. Adelie, gentoo and chinstrap penguins (known as brush-tailed penguins) have 14 to 18 stiff tail feathers, which they often use as a prop when on land.



Penguins have about 80 **feathers** per square inch—more than any other bird. Penguins need all of those feathers to keep warm and dry. The fluffy down at the base of each feather traps air near the penguin’s skin. This air layer helps penguins keep warm, even in cold air and frigid water. When penguins are too warm, they fluff their feathers to release extra body heat.

The outer tip of each feather is stiff and small. Every feather tip overlaps with those around it, like shingles on a roof. This is what keeps penguins dry in the ocean. The tips of the feathers get wet, but the fluffy down stays dry and warm.

Penguins replace their feathers, or molt, once a year. Every year during a two to three-week period, they shed their feathers and grow a complete new set. This means penguins have to keep their feathers healthy for a whole year. Because of this, most penguins spend hours every day taking care of their feathers, a behavior known as grooming or preening. A grooming penguin first cleans each feather, removing dirt and water. Then it conditions the feathers by spreading out oil from a gland at the base of its tail.

Penguins are vulnerable to predators and cold temperatures during molting. The old feathers are no longer waterproof or insulating and the bird cannot enter the ocean to catch food or to escape land predators. Because penguins fast during the molting period, they must gorge themselves for a few weeks prior to molting. They live off stored fat until new feathers grow in.



Senses

As in most birds, penguin hearing is thought to be good.

Vocalizations (calls) are important in communication and mate recognition. Penguins have good vision both on land and under water, since they can change the shape of their cornea. The sense of taste in penguins has not been extensively studied. In general, the sense of taste is poorly developed in birds. Penguins' sense of smell may be more developed than early studies indicated since the olfactory lobe of a penguin's brain is large.

Food

Penguins only eat seafood and swallow their food whole since they don't have teeth. They use their powerful, sharp beaks to catch fishes, squid and krill. Their tongues have a rough, Velcro-like texture that—along with a hooked beak—helps them hold and swallow their slippery food. The New England Aquarium's 65 penguins eat nearly 600 pounds of sardine, capelin, smelt and herring every month. Most of them eat five to ten fishes every day.

Adaptations

How penguins stay warm and dry:

The downy under portion of the feathers traps a layer of air against the skin. This layer of air is then warmed by body heat, much the way our body heats the air in a down jacket. Their feathers overlap like shingles on a roof and form a barrier, keeping water away from the skin. Penguins also have a layer of blubber, or fat, under the skin. As a rule, larger penguins live in colder areas. This is because larger, rounder bodies lose heat slower than smaller, slimmer bodies. This explains why Antarctica's emperor penguins, which survive the harshest winters, are the largest penguins in the world.

How penguins stay cool:

Some penguin species have bare patches (heat windows) around their eyes. These areas have no feathers and allow excess heat to escape. The patches become very pink when the penguin is warm. Penguins can voluntarily raise their feathers to let the warm air escape. Penguins have many tiny blood vessels (capillaries) close to the skin on their wings, which helps them to cool down by just holding their wings out and letting the air move across them. Penguins can release heat through their feet, where they have a counter-current blood exchange system.

How they swim:

A streamlined body, webbed feet and oar-like wings enable penguins to shoot through the water at speeds up to 15 miles per hour. It is often said that penguins look like they are flying through the water. Underwater quickness and the ability to hold their breath aid penguins in catching prey. All penguins use their short, stiff wings for propulsion and their webbed feet for steering. The position of their feet on the lower part of the body aids in both steering and hydrodynamics.



How they hide:

As mentioned before, penguins have black backs and white bellies. This pattern of coloration is called countershading and serves to camouflage the bird when it is in the water. Since penguins spend most of their time in the ocean, this coloration is an effective form of protection. Countershading also helps the penguins hunt with more success.

How they dive deeper:

Most birds have hollow bones, making them lighter for flying. Penguins, however, have solid bones, making them heavier and making it easier to dive underwater for food.

How they shake off the salt:

Penguins have almond-shaped glands beneath the skin above their eyes that help them filter out the excess salt from the ocean. The salt drips down their beak, the penguins make a sneeze-like sound, and they are able to shake it off.

Reproduction

Male and female penguins look alike, even to the trained eye. Observing mating behavior, performing an internal examination, or doing DNA analysis are the only ways to distinguish male from female penguins. The reproductive behaviors such as mating, courtship and nesting differ from species to species. The color, shape and size of eggs also differ.



Penguin Species



Adelie

Pygoscelis adeliae

Standing height: 18-24 inches

Weight: 8-10 pounds

Home: circumpolar on Antarctic continent and the surrounding waters within limits of pack ice

Lower risk population estimated at 4,931,600 birds

The Adelie penguin is the characteristic “tuxedo” penguin of Antarctica.

This species, along with the emperor penguin, is restricted to Antarctica and the surrounding waters.



African

Spheniscus demersus

Standing height: 25-27 inches

Weight: 6-8 pounds

Home: South Africa and Namibia

Vulnerable population estimated at 180,000 adults

African penguins nest in burrows for protection from the hot sun and predators.

They are referred to as jackass penguins since their vocalizations sound like braying donkeys.



Chinstrap

Pygoscelis antarctica

Standing height: 28-30 inches

Weight: 8.5-9.5 pounds

Home: Circumpolar, breeding south of the Antarctic convergence on islands and on the Antarctic peninsula

Lower risk population estimated at 15,000,000 birds

The chinstrap penguin is the second-most numerous penguin in the world. This penguin belongs to a group of penguins known as the brush-tailed or stiff-tailed penguins.



Emperor

Aptenodytes forsteri

Standing height: 36-44 inches

Weight: 60-90 pounds

Home: Marine, circumpolar, within the Antarctic zone, approximately 40 colonies scattered around Antarctica, most on fast ice

Lower risk population estimated at 436,200 birds

The emperor penguin is the largest of all penguins. This penguin endures the harshest weather of any species on the planet.



Erect crested

Eudyptes sclateri

Standing height: 25 inches

Weight: 6-7.7 pounds

Home: Both islands of New Zealand, with some birds on Antipodes, Bounty and Auckland Islands. Non-breeding range at sea is unknown.

Vulnerable population estimated at 330,000 birds

All species of crested penguins have heads adorned with yellow feathers.



Fiordland

Eudyptes pachyrhynchus

Standing height: 24 inches

Weight: 6-7 pounds

Home: sub-Antarctic islands and New Zealand

Vulnerable population estimated at 5,000-6,000 birds

The Fiordland penguin is considered the most timid and the most rare of the crested penguins.



Galapagos

Spheniscus mendiculus

Standing height: 21 inches

Weight: 5-6 pounds

Home: Lives year-round on the Galapagos Islands of Fernandina and Isabela, 600 miles west of Ecuador

Endangered population estimated between 3,000 and 8,000 birds

This penguin is a truly tropical weather penguin, living on the hot desert islands of the Galapagos at the equator—making it the most northerly penguin species.

Temperatures often exceed 100 degrees in this region.



Gentoo

Pygoscelis papua

Standing height: 30-35 inches

Weight: 10-14 pounds

Home: Around the globe on sub-Antarctic islands and the Antarctic peninsula

Lower risk population estimated at 628,000 birds

The gentoo penguin belongs to a group of penguins commonly known as brush-tailed penguins, which also include the Adelie and chinstrap penguins. The gentoo is the most timid of the three.



Humboldt

Spheniscus humboldti

Standing height: 18-24 inches

Weight: 6-11 pounds

Home: The western coast of South America (Peru and Chile). Although the air temperature can be warm, the water of the Humboldt current is very cold.

Vulnerable population estimated at 13,000 birds

The Humboldt penguin populations have declined seriously during the past century due to many factors, including loss of good nesting sites, reduced food supply, predation and the impact of increasingly severe El Niño fluctuations. Biologists are working toward their conservation.



King

Aptenodytes patagonicus

Standing height: 37 inches

Weight: 30-45 pounds

Home: sub-Antarctic and Antarctic islands

Lower risk population estimated at 3,276,890 birds

The king penguin is the second largest of all penguins. They are gregarious by nature, gathering in colonies by the thousands. Kings are found in their colonies year round because it takes them 15-18 months to raise their single chick.

Little blue

Eudyptula minor

Standing height: 10-12 inches

Weight: 2-3 pounds

Home: Australia and New Zealand. The inshore habits of this species have caused isolated groups to evolve into 6 recognized subspecies.

Stable population estimated at 700,000-1,200,000 birds.

The little blue penguin is the smallest species of penguin in the world and is found exclusively in Australia and New Zealand. This penguin employs a wide range of songs more extensively than any other penguin species. From an evolutionary standpoint, the little penguin is also considered the most primitive.



Macaroni

Eudyptes chrysolophus

Standing height: 28 inches

Weight: 9-13 pounds

Home: Spends 75% of its time at sea. Breeds on steep, rocky sub-Antarctic islands close to the Antarctic convergence in the South Atlantic and Indian oceans, with one breeding colony located on the Antarctic peninsula

Vulnerable populations estimated at 18,000,000 to 23,000,000 birds

The name macaroni describes their yellow crest feathers, which resemble an eighteenth century hat fashion worn by young Englishmen. Macaronis are the largest crested penguin. They breed closer to Antarctica than any other crested penguin, and even have one breeding colony on the Antarctic peninsula.



Magellanic

Spheniscus magellanicus

Standing height: 14-22 inches

Weight: 7-15 pounds

Home: central Chile and central Argentina, south to Cape Horn and the Falkland Islands

Lower risk population estimated at 2,600,000 birds

The Magellanic penguin is the most numerous of four species of the genus Spheniscus. The other three species are the Humboldt, African and the Galapagos penguins.





Rockhopper

Eudyptes chrysocome

Standing height: 18- 23 inches

Weight: 4.5-8 pounds

Home: Breed on rocky islands located in the sub-Antarctic and south temperate regions of the Indian and South Atlantic oceans. Great distances between these island groups have resulted in the evolution of three subspecies.

All three rockhopper subspecies are considered **vulnerable**.

Northern rockhopper: 700,000 adults, Southern rockhopper: 950,000 adults,

Eastern rockhopper: 1,664,000 adults

The name rockhopper describes the way this species hops around the steep, rocky places where they live for part of the year.



Royal

Eudyptes schlegeli

Standing height: 26 inches

Weight: 12 pounds

Home: Breeding is restricted to Macquarie Island off New Zealand and adjacent islets. Wintering range is sub-Antarctic water.

Vulnerable population estimated at 1,700,000 birds

The royal penguin is the only crested penguin to have a white face and throat.



Snares Island

Eudyptes robustus

Standing height: 25 inches

Weight: 6-7 pounds

Home: New Zealand, breeds only on Snares Island chain. Non-breeding range extends to other nearby islands in the Pacific.

Vulnerable population estimated at 46,500 birds

The Snares Island penguin breeds only on the densely forested Snares Islands. It is the only penguin that actually roosts in low trees.



Yellow-eyed

Megadyptes antipodes

Standing height: 21 inches

Weight: 11.5-13 pounds

Home: Southeast coast of New Zealand's South Island, including Stewart, Campbell and Auckland Islands

Vulnerable population estimated at 4,000-7,000 birds. Population has decreased by 40% over the last 40 years.

The yellow-eyed penguin is the most reclusive of all penguin species. These penguins seek out sheltered nests completely isolated from their neighbors. In fact, if two pairs are within sight of each other, both will experience an unsuccessful breeding season.

Threats to Penguins

Historically, penguins were hunted for their meat, feathers, fat and eggs. Plus, their droppings (guano) were highly valued as garden fertilizer. Layers of clay-like guano, hundreds of feet deep, were removed, depriving temperate penguins of nesting burrows. Penguin populations never fully recovered from these activities.

Today there are new threats to penguins, and many species are in danger.

Oil Spills

Big oil spills are horrible events. The *Treasure* oil spill put nearly 40,000 penguins at risk. But, perpetual small leaks, illegal dumping and poor regulations are actually much greater threats to penguins and other marine life. Oil tankers are designed to travel the open seas fully laden with oil, and they would be dangerously unstable with empty holds. In order to counteract this risk, empty oil tankers will pump ocean water into their holds. This ballast water provides the necessary weight to allow the ship to move safely to its next port, where it should pump the water from its tanks in order to prevent it from polluting the sea.

This process is highly regulated, but unevenly enforced, and many tankers empty their tanks directly into the sea before entering port. Illegal dumping saves the ship some time, and often some money, but it puts local marine life at significant risk. The ballast water is contaminated with oil from the ship's hold. No oil spill has occurred, but an oil slick has been created. This unsavory practice is all too common, and extremely difficult to prevent. As a result, oil slicks are a nearly constant feature near many of the world's shipping ports.

Oil kills penguins. It coats their feathers, leaving them without much-needed insulation. Penguins then ingest the toxic oil when they attempt to clean their feathers. The swallowed oil can cause stomach lesions and may depress their immune systems. The oiled penguin is helpless to save itself. Being rescued and cleaned is their only hope.

Habitat Loss

In many parts of the world, penguins nest on the same beaches where people work, play or relax. In the past, penguins would lose when penguins and people wanted to use the same stretch of beach or scrub habitat. Today, penguin nesting habitats are beginning to be protected, although habitat loss remains a significant threat for many of the world's penguins.

Commercial Fishing

In recent years, as commercial fishing has become more efficient, people have been catching and eating more fish than ever before. Commercial fishing has depleted some fish populations to such a degree that there are sometimes not enough fish left to feed penguins and other fish-eating marine animals. This is a particular problem near popular penguin breeding sites. There, hundreds or thousands of adult penguins may be

concentrated for weeks or months, fishing heavily to feed themselves and their growing chicks.

Introduced Predators

Most birds can escape to the safety of the air if a predator threatens, but flightless birds can only walk, run, waddle or swim away from their predators. Because of this, flightless birds have a long and tragic history of extinctions following the introduction of non-native predators or competitors. Many flightless birds evolved on small, predator-free islands, and have no natural defenses. Such was the case for the dodo, which survived barely 200 years past its discovery. Today, introduced predators are threatening many penguin species. On New Zealand, introduced rats steal little blue penguin eggs and newly hatched chicks, while foxes, dogs and cats stalk adult penguins. In New Zealand and elsewhere, scientists and conservationists are working on the nearly impossible task of finding ways to control or remove introduced species.

Climate Change

Global climate change may result in shifting ocean currents, rising temperatures, melting ice caps and a myriad of other threats to penguins and other creatures. Antarctica's penguins—which have been largely spared most other human-caused threats—may suffer the most from climate change. These birds like the cold. They need the cold. Emperor penguins, the lovable stars of the blockbuster *March of the Penguins*, rely on the shrimp-like krill for the majority of their diet. These krill, in turn, rely on sea ice, which leads to greater algae production. Less algae is produced in summers when the sea ice shrinks due to rising temperatures. Less algae leads to less krill, which means hungry penguins and starving chicks.

How People Can Help Penguins

Penguins are cute and lovable. But, as much as we adore them, many penguin species are facing multiple threats in the wild. And, people are a big part of the problem. Thankfully, people can also be a big part of the solution.

Take care of the oceans.

The world's oceans are all connected and no matter where we live, our daily actions have an impact on them. Help keep the oceans clean by disposing of your trash properly, and picking up litter on the beach or in the street.

Help slow climate change.

Global climate change may cause temperatures to increase, ice caps to melt and ocean levels to rise. Help slow climate change by reducing your daily energy use and driving less often.

Make a donation.

By supporting the New England Aquarium, you support penguins and conservation efforts here and around the world.

Sponsor a penguin.

Sponsor a penguin through our Proud Parent Program. For more information, call 617-973-0295 or visit www.newenglandaquarium.org and click on “Animal Sponsorship.”

Give time.

The Aquarium relies on volunteers to help feed our fishes, care for our penguins and educate our visitors. For more information, call 617-973-5235, e-mail vols@neaq.org or visit www.newenglandaquarium.org and click on “Volunteer.”

Share your knowledge with others.

When you introduce your friends and family to penguins, you are helping by sharing your knowledge with others. Bring a friend or family member to visit the penguins at the Aquarium. Talk with your friends about the threats facing penguins and other sea creatures. And stay informed about conservation efforts.

Other Conservation Measures

Currently all 17 species of penguins are legally protected from hunting and egg collecting. At least 10 of the 17 species are considered at risk. The Antarctic Treaty was signed by 12 nations in 1959 and reauthorized in 1991 to protect Antarctica and preserve its living resources. The treaty makes it illegal to harm, or in any way interfere with, a penguin or its eggs. Every penguin specimen collected with a permit must be approved by and reported to the Scientific Committee for Antarctic Research. Education and awareness programs play a significant role in conservation. Many aquariums, zoos and other organizations are constantly educating people about penguins.

Penguins at the New England Aquarium

We have three species of penguins here at the New England Aquarium: African penguins, rockhopper penguins and little blue penguins. We participate in the African penguin Species Survival Plan (SSP), which is a cooperative population management and conservation program for certain species in zoos and aquariums in North America. Each SSP manages the breeding of a species to maintain a healthy population that is both genetically diverse and demographically stable. SSPs also participate in a variety of other activities, such as research, public education, reintroduction and field projects.



African penguin

Spheniscus demersus

Standing height: 25-27 inches

Weight: 6-8 pounds

Home: South Africa and Namibia

Vulnerable population estimated at 180,000 adults

African penguins live to be about 10-18 years old in the wild, but can live into their 20s and 30s in zoos and aquariums. The New England Aquarium had an African penguin that lived to be at least 38 years old.

African penguins nest communally in large rookeries on rocky islands or islands composed of peaty soil and scrub brush. African penguins usually mate for life. Together, they dig a one to two-foot deep burrow into dirt or layers of dried guano. In this burrow, the pair builds a nest of stones and twigs. The female usually lays two eggs, called a clutch, in this nest. They alternate the egg-sitting duties, both aggressively defending their eggs from predators. After incubating for 38-42 days, the penguin chicks hatch. Often only one chick hatches because only one of the eggs is fertile. The hatchlings are covered with brownish-gray downy feathers and are quite helpless. Both parents guard and feed the chicks for two to three months until the chicks molt for the first time. This initial molting process is called fledging. During this molt, the chicks shed their downy feathers and replace them with waterproof feathers with a juvenile coloration of gray on the back and ivory on the front. After fledging, they join the adults and fend for themselves. At 1.5 to 2 years old, the chicks molt again, when their new plumage is the familiar black and white adult coloration.

Rockhopper penguin

Eudyptes chrysocome

Standing height: 18- 23 inches

Weight: 4.5-8 pounds

Home: Breed on rocky islands located in the sub-Antarctic and south temperate regions of the Indian and South Atlantic oceans. Great distances between these island groups have resulted in the evolution of three subspecies.

All three rockhopper subspecies are considered **vulnerable**.

Northern rockhopper: 700,000 adults, Southern rockhopper: 950,000 adults, Eastern rockhopper: 1,664,000 adults

The Aquarium has two subspecies of rockhoppers, Northern and Southern rockhoppers.

Rockhoppers are named for their excellent jumping ability.

Rockhopper penguins live communally in large crowded rookeries and build their nests on steep, rocky hillsides. They line their nests with sticks, bones, vegetation and stones. Very often a pair uses the same nesting territory season after season. Both the male and female rockhoppers take turns incubating their two eggs for 36 days. The second egg laid is larger than the first, and usually only one chick hatches because the parents typically push the first egg out of the nest once the second egg is laid. Both parents care for the chick for about 70 days before it becomes independent.



Little blue penguin

Eudyptula minor

Standing height: 10-12 inches

Weight: 2-3 pounds

Home: Australia and New Zealand. The inshore habits of this species have caused isolated groups to evolve into 6 recognized subspecies.

Stable population estimated at 700,000-1,200,000 birds.



As the smallest species of penguin in the world, little blue penguins reach only 8-10 inches tall and weigh 2-3 pounds. Little blues leave their burrows before sun-up and hurry out to sea where they spend all day fishing. They return to their burrows after the sun has gone down. Rushing to and from the sea under the cover of darkness helps them avoid avian predators. The Aquarium's original little blue penguins came from the Melbourne Zoo in Australia. They are the offspring of rehabilitated birds that had permanent injuries. Because of these injuries they would not have survived in the wild.

Several little blue chicks have hatched here at the Aquarium.

Similar to the African penguins, little blues make their nests in burrows. These burrows can be made in sand dunes, among rocks, in sea caves or in headlands. Little blues often mate for life and they usually breed between August and March (this is summer in the

Southern Hemisphere). The female usually lays two eggs per clutch and sometimes lays two clutches in a breeding season, provided there is enough food available. The little blues sit on the eggs for 35-40 days until they hatch. Eight to ten weeks after hatching, the chicks leave their parents and head out to sea. Like all penguins, the chicks are not taught to swim or catch food by their parents; that knowledge is attributed to instincts as well as trial and error. Unfortunately, learning to survive in the wild is very difficult, and many penguin chicks never survive to adulthood. Once they make it to adulthood however, their chances for survival are very good.

About the New England Aquarium's Penguin Exhibit

The penguins are fed two times a day, at 9 a.m. and again at 2:30 p.m. Each feeding takes approximately one hour. Our penguins are hand-fed sardine, capelin, smelt and herring. Most of them eat five to ten fishes every day. The fish is purchased in large, frozen blocks and then thawed. Frozen fish is less expensive and easier to store than live fish, and the freezing process kills bacteria and parasites. It would be difficult to monitor the diet of each penguin if they were allowed to catch live fish swimming in the exhibit. By hand feeding, the handlers are able to record how a penguin is eating and monitor their physical state (i.e. if they are gestating an egg, getting ready to molt or not feeling well). Three days a week, the penguin handlers hide vitamins in the fish so penguins are sure to get all the nutrients they need.

Aquarium penguins are banded according to sex—males have a bracelet on the left wing and females on the right wing. The wing bands are for identification and do not interfere with their motion. Each penguin also has a name.

The Aquarium has a population of African penguins with a diverse and healthy gene pool (meaning they are not closely related), which allows healthy offspring to be produced.

At the New England Aquarium, African penguin parents lay two eggs in the cave-like burrows that are built into the fiberglass islands. The parents incubate the egg(s) and, after hatching, they feed and care for the chick for about one month (usually only one egg is fertile, but sometimes both are). The chick is then removed and hand reared by staff members behind the scenes. The chick is removed from the exhibit to break the parent-chick bond (otherwise the chick would harass the parents for food longer than it would in the wild) and to familiarize the chick with taking food from humans. After growing its first set of waterproof feathers, the chick is reintroduced to the exhibit as a juvenile.

Like the African penguins, the little blue penguins nest in burrows and lay their two eggs at the far end of the long, tunnel-like burrows that are built into their island. They can raise two chicks at a time, but are more likely to raise one.

The rockhopper penguins are surface nesters and build their nests on the tops of islands using small stones that are provided by penguin staff.

The rocks in the exhibit are artificial. They are molded from fiberglass to look and feel like real rock. Real rocks of that size would be too difficult to get into the exhibit and would be too heavy for building the structure.

The water in the exhibit is filtered harbor water and is about the same temperature as the water outside. It ranges from about 50 to 65 degrees F. The water is three to four feet deep.

The cleaning solution used to wash and disinfect the rocks is a biodegradable veterinary disinfectant that is safe and non-toxic to both the birds and the environment.

Each penguin has a favorite area where it spends most of its time when it is not swimming. They defend their territory with much determination. Most of the rockhoppers stay on the island in the back of the exhibit. Although they have their favorite spots, the African penguins and rockhopper penguins can go anywhere in the exhibit. The little blue penguins remain in the gated area, where they have established their territory and are accustomed to breeding.

Frequently Asked Exhibit Questions

How many penguins are there?

We have 65 penguins, representing three species, in our colony at the New England Aquarium.

How big is the exhibit?

The penguin exhibit contains 150,000 gallons of filtered Boston Harbor seawater. The temperature of the water is chilly mid-50s during the winter months. When summer arrives, the temperature rises into the upper 60s.

Do the penguins need sunlight?

All of our penguins receive vitamins three times a week to supplement the nutrients lost from eating frozen fish and from the lack of natural sunlight. We give our penguins B1, multivitamins and Vitamin E. The lights in our exhibit are set to timers that mimic a Northern Hemisphere daylight cycle, including a gradual sunrise and sunset.

How do the rocks float?

The rock islands do not float. Each one is attached to several pedestals that connect it to the floor. The rocks are made of fiberglass, like the coral in the Giant Ocean Tank. Each island is hollow in the back, which allows the staff to access the inside of the penguins' burrows without disturbing them.

What kind of soap is used to clean the rocks?

The exhibit is cleaned using a veterinary disinfectant. It is not harmful to the birds in any way.

Why does it smell?

In the wild, you can smell a penguin colony before you see it! A penguins' sense of smell is not their strongest sense, and their diet of fish (and squid and krill in the wild) encourages a very potent smell of guano. This is why we clean the rocks in the exhibit every morning.

What are those black things on the rocks?

They're sprinklers! We don't have waves, wind or rain in the exhibit to rinse off the islands, so the sprinklers spray salt water three times a day to simulate these natural environmental actions.

Why are the little blues separated from the other species?

The penguin staff need to make sure that there are not any spaces where the little blues can get stuck since they are so much smaller than the Africans and the rockhoppers. Also, it is a very labor-intensive process to introduce new penguin species to each other.

How do the penguin staff members keep the rockhoppers away from the Africans?

When the rockhoppers first arrived at the New England Aquarium in 1985, there was a gate that separated them from the rest of the exhibit. During this time, the rockhoppers were allowed to establish their domain on Rockhopper Island. Although some pairs have bred on the African penguin islands, the majority are lured back to Rockhopper Island by the activities of their own species.

Do the penguins breed here?

We have a healthy breeding colony of penguins. Many of our penguins have bred here at the New England Aquarium.

Are those babies?

Although the little blues look like baby penguins, they are full grown adults. Little blues are the smallest species of penguin in the world. They reach only 10-12 inches in height and weigh 2-3 pounds.

Are the penguins with the yellow "hair" the dads?

The rockhopper penguins have yellow crest feathers, not hair. Both the males and females have crests of the same length. As juvenile rockhoppers become adults, their crests develop.

Why don't they breed with each other?

Their breeding behaviors are different enough that the stimulus does not encourage interbreeding.

Is that penguin sick/balding?

No, they are just molting. A penguin's feathers are extremely important to their survival. Every year, penguins molt—they replace old feathers with new ones. During molting, penguins are not waterproof, so they must stay on land until their new feathers grow in. When the new feathers are pushing the old feathers out, penguins look scruffy and swollen.

Why do the penguins have their wings out/puff up/turn pink around their eyes?

When penguins need to cool down, they can extend their wings to release heat. African penguins also have heat patches around their eyes and on their feet, which turn pinker as the penguin gets hotter. They will also puff out to let heat escape from beneath their feathers. You may also notice the air bubbles that escape when penguins are swimming underwater—this is the warm air that is trapped under the feathers to keep them warm.

Why do the penguins hesitate before jumping in the water?

They could be checking for predators before taking the plunge. In the wild, some predators of penguins, such as leopard seals, fur seals or some sharks, could be lurking just below the surface of the water.

Do the penguins fight?

Our penguins exhibit natural behaviors. Penguins are very territorial by nature and will display aggressive behaviors if they feel threatened by intruders into their territory. Young males are especially aggressive at the beginning of the breeding season.

Why are the penguins hand fed?

This ensures that the staff gets a chance to monitor every penguin's health every day. Records are kept of what each penguin eats.

Do they make good pets?

No. Penguins are wild animals with extremely sharp beaks, and their guano alone would make them an unwelcome addition to the household! Also, penguins are colonial animals, so a single penguin as a pet would not be a good idea.

What do you do if a penguin needs special attention?

The penguin holding room is a space for penguins that need special attention. Penguins are housed here for reasons such as health care, breeding and management of aggression during the breeding season.

Why do the penguins have bracelets?

Each of our penguins has a bracelet with their own color pattern so the staff can distinguish one bird from another. Males have their bracelets on the left and females on the right. The bracelets are not tight on the penguins' wings.

Are the penguins with gray heads a fourth species?

No, African juvenile penguins are a sleek, silver-gray color. After about two years, they will then molt into their black and white adult plumage.

How long can penguins stay under water?

On average, penguins stay under water for only a few minutes at a time. Rockhopper, African and little blue penguins may dive as deep as 160 feet, but a more common depth could be 30-60 feet while hunting. The largest penguin species, the emperor, was recorded diving as deep as 1,752 feet and can stay under for as long as 18 minutes!

How fast can they move on land?

Penguins are fairly awkward on land compared to their grace under water. However, a penguin can move quickly if threatened—faster than most humans!

Penguin Vocabulary

burrow: a hole dug in the dirt as a nesting site or shelter

camouflage: features such as coloration that help an animal hide in its natural surroundings

countershading: the dark back and light belly coloration of some marine animals (sharks, rays, penguins) that helps camouflage them in the open ocean

chick: a baby penguin

habitat: the place where a animal or plant lives

incubate/incubation: to sit on eggs to maintain a favorable environment for hatching

krill: a shrimp-like animal

molt: annual process by which penguins shed their old feathers and replace with new ones

predator: an animal that hunts another animal for food

preening: in birds, the use of the beak to clean, arrange and condition the feathers

prey: an animal hunted by another animal for food

regurgitate: to vomit partially digested food; penguin parents will regurgitate fish to feed their chicks

rookery: nesting place for a colony of birds

Southern Hemisphere: the portion of the earth located south of the equator

territory: the area an animal defends as its own

Penguin Worksheet #1

Read about penguins and answer as many of these questions as you can.

1. True or False? Polar bears are the main predators of penguins.
2. What is molting? Why do penguins go through this process?
3. What features do penguins share with other birds?
4. How are penguins different from most birds?
5. Why do penguins spend so much of their lives in the ocean?
6. What is countershading and how does it protect penguins? Can you name any other ocean animals that are also protected by countershading?
7. Baby penguins are called _____.
8. Which is the largest species of penguins? _____
9. Which is the smallest? _____
10. True or False? Penguins never have to worry about getting too hot because they all live at the South Pole.

Penguin Worksheet #2

1. What are two characteristics penguins share with all birds?
2. All penguins live in which hemisphere?
3. What species of penguins do we have at the New England Aquarium?
4. What do penguins eat in the wild?
5. What do the penguins at the New England Aquarium eat?

Penguin Word Search

P	E	N	G	U	I	N	O	P	E	G	G	S	Q
B	A	D	O	L	Y	E	I	G	M	K	B	X	M
R	A	E	R	O	C	K	H	O	P	P	E	R	E
F	N	I	X	W	O	L	C	K	E	B	A	A	O
W	T	R	F	E	A	T	H	E	R	S	K	C	I
I	A	P	I	U	D	V	I	M	O	Z	D	Y	L
N	R	K	S	T	E	U	C	K	R	I	L	L	S
G	C	U	H	S	L	H	K	S	P	C	A	E	P
S	T	G	O	P	I	G	T	C	B	I	R	D	I
V	I	N	H	Q	E	A	O	E	F	D	H	K	L
S	C	H	E	M	I	S	P	H	E	R	E	M	L
P	R	E	E	N	I	N	G	I	H	J	L	N	S

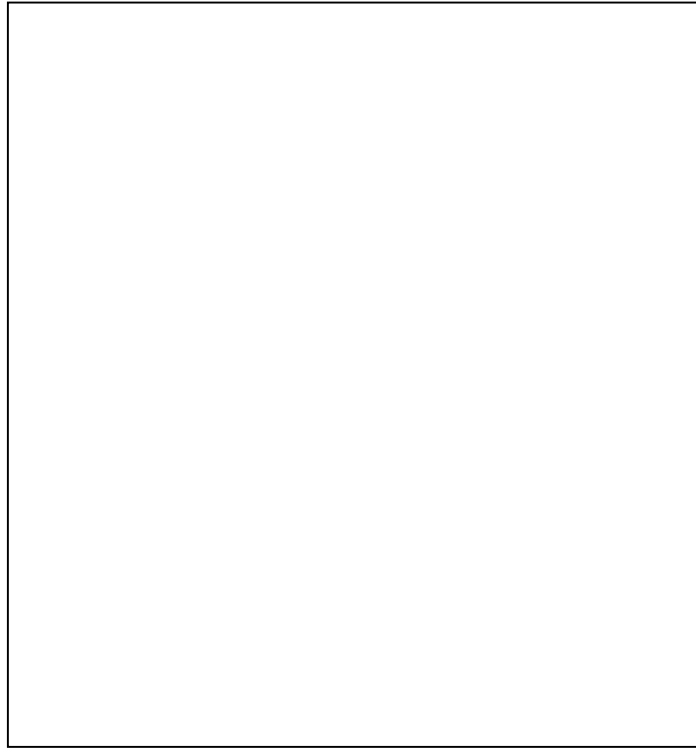
Find and circle the words that are hidden in the puzzle. All words should read from top to bottom or from left to right. You should find 15 plus one bonus word.

- | | | |
|---------------|------------|-----------|
| 1. Hemisphere | 6. Penguin | 11. Eggs |
| 2. Antarctic | 7. Emperor | 12. Beak |
| 3. Rockhopper | 8. Wings | 13. Krill |
| 4. Preening | 9. Adelie | 14. Fish |
| 5. Oil Spills | 10. Chick | 15. Bird |

Penguin Watch #1

Biologists observe animals and describe their behavior. This helps scientists understand how animals live: how they find food, protect themselves and interact with other animals and each other.

For this activity, choose one penguin and observe it carefully for five minutes. Most of the penguins have colored bracelets. This makes it easier for the Aquarium staff to identify them. Look for your penguin's bracelet. What color is it? Is it on the right or left wing? (Females have bands on their right wings, males on the left.) Use the bracelets to help you keep track of your penguin and watch its behavior closely. Make a simple sketch of your animal.



Name of your penguin:

Male or Female?

Color(s):

Size:

Penguin Watch #2

Observe your penguin for five minutes and take notes on what your penguin is doing in that time.

____ swimming
____ sleeping
____ eating

____ sitting on a rock
____ building a nest
____ preening

____ fighting
____ jumping
____ molting

Can you find another penguin near yours with the same color bracelet? This is its mate. Penguins in our exhibit with the same colored armbands are mated pairs. How many pairs of penguins can you find?

Watch a penguin as it dives. When its beak is under water, start counting or look at the second hand on your watch. Note when the penguins come up for air. How many seconds was it underwater?

Based on your observations, predict the behavior of this penguin in the wild. How could this penguin find and catch food?

How could this penguin defend itself?

How does this penguin interact with other penguins?

Did you observe any other unusual features?

Game:
A Penguin Adventure!

For four to six players.

Rules of play:

Each player takes a penguin model as a marker. Note that each penguin has a different bracelet on its wing.

WILD CARDS are placed face down in the proper space on the game board.
FOOD CARDS are placed in their labeled spaces.

Choose who goes first by rolling a single die. The highest number goes first. In case of a tie, roll again.

Players roll the dice and move the appropriate spaces on the board. Note: The game can be played with one die (for a slower-paced game) or with a pair of dice (for a faster-paced game).

When a player lands on a darker blue circle, he or she follows the directions and will either pick up food cards (squid, krill or fish indicated by the drawings) or face the consequences of meeting hungry predators and other dangers.

When a player is forced to drop a FOOD card, he or she must put it back into the correct pile on the board. When a player is directed to pick up a number of FOOD cards, he/she may pick up any of the three types of FOOD cards available. But remember, each type of FOOD card gives the player a different number of points!

The player who reaches or passes HOME SAFE! first gets 10 extra points.

Each player tallies up the number of FOOD cards they have.

Scoring:

KRILL cards: 1 point each

SQUID cards: 2 points each

FISH cards: 3 points each.

The player with the highest number wins.

Activity Ideas

Mural: On a large map, find the areas where penguins are found throughout the Southern Hemisphere. On a separate piece of paper, draw picture of each penguin species. Then, cut the pictures out and attach them to the map where that penguin is found.

Research: Research the natural history of penguins and write a short report and include an illustration on each one of the 17 different species. Compile the reports and illustrations in a book for all to share.

Food webs: Penguins are a part of a food chain that may include shrimp, fish, krill, whales and seals. Construct a simple food web that shows which animal eats what.

Birds: Discuss how penguins compare with birds that live in your neighborhood. Discuss the things that all living things need to survive. What special adaptations do different birds have that allow them to survive in their habitats?

Create-a-bird: Penguins are very well adapted to their life at sea. They have heavy bones, streamlined bodies and waterproof feathers. Think about how adaptations help an animal survive. Then design your own bird with features to help it survive in an unusual habitat—such as in the desert, on the moon, in a city or on top of a mountain. What would it look like? What would it eat? How would it protect itself?

My Life as a Penguin: Based on your knowledge of penguins, write a short story called “My Life as a Penguin.”

Conservation: Many penguin species are in danger Discuss other endangered and protected species such as the bald eagle, peregrine falcon, or the North Atlantic right whale. What are the reasons these animals are threatened? How can we help these animals?

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